

North Central Tennessee Regional Water Supply Planning Pilot Study

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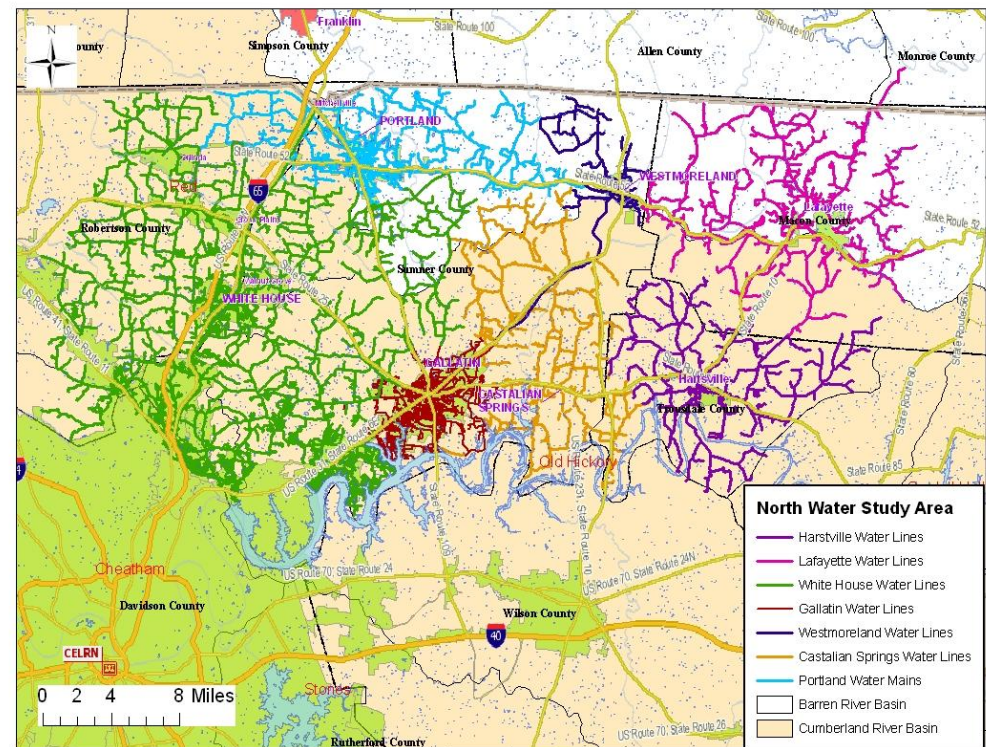
Presentation Outline

- Phase I Overview
- Phase II Tasks
- Phase II Progress
- Questions and Comments



Phase I Overview

- Collection and documentation of existing water source information, use, and demand for study area
- Collection and documentation of existing water distribution system and wastewater discharge information
- Development of GIS Database



Phase II Tasks

- Regional Drought Evaluation
- Existing Water Source Yield Analyses
- Water Demand Management Strategies
- Alternative Water Source Identification
- Alternative Water Source Yield Analyses



Phase II Progress

- Regional Drought Evaluation
 - ▶ Utilizes Standardized Precipitation Index – reflecting probability of occurrence for rainfall totals of selected duration
 - ▶ Practical limits of -4 to 4, beyond which the probability of occurrence is too low to detect within standard periods of record

SPI Values	
2.0+	extremely wet
1.5 to 1.99	very wet
1.0 to 1.49	moderately wet
-.99 to .99	near normal
-1.0 to -1.49	moderately dry
-1.5 to -1.99	severely dry
-2 and less	extremely dry



Phase II Progress

- Regional Drought Evaluation
 - ▶ Study Area Precipitation Record: 1928 – 2009
 - ▶ Critical drought duration varies according to reservoir size and shape, demand, and watershed characteristics
 - ▶ SPI computed at multiple durations: 1 month to 60 months



Phase II Progress

Drought	3	6	9	12	15	18	24	30	36	42	48	54	60
1930-1934	-3.15	-3.14	-3.07	<u>-3.62</u>	-3.17	-3.06	-2.22	-1.48	-1.61	--	--	--	--
1941-1946	-2.69	<u>-3.09</u>	-2.71	-2.19	-2.28	-2.23	-2.61	-2.28	-2.41	-2.56	-2.46	-2.53	-2.38
1953-1958	<u>-3.64</u>	-3.39	-2.44	-2.4	-2.33	-2.4	-2.5	-2.39	-2.60	-2.47	-2.7	-2.44	-2.49
1963-1966	-2.4	<u>-2.53</u>	-1.99	-1.78	-2.10	-1.84	-1.76	-1.72	-1.52	-1.53	-1.65	-1.54	-1.51
1986-1988	<u>-2.77</u>	-2.36	-2.15	-1.95	-2.21	-1.95	-1.59	-1.45	-1.50	-1.99	-1.55	-1.17	-0.87
2007-2008	-1.89	<u>-2.49</u>	-2.21	-1.75	-1.52	-1.54	-1.79	-1.66	-0.99	--	--	--	--

Critical 3 to 60 months duration SPI values for droughts in the North Central Study Area

- Early 1930's, early 1940's, mid 1950's droughts are dominant droughts at all durations
- 1930's and 1950's droughts are likely critical for study area - intensity at short duration



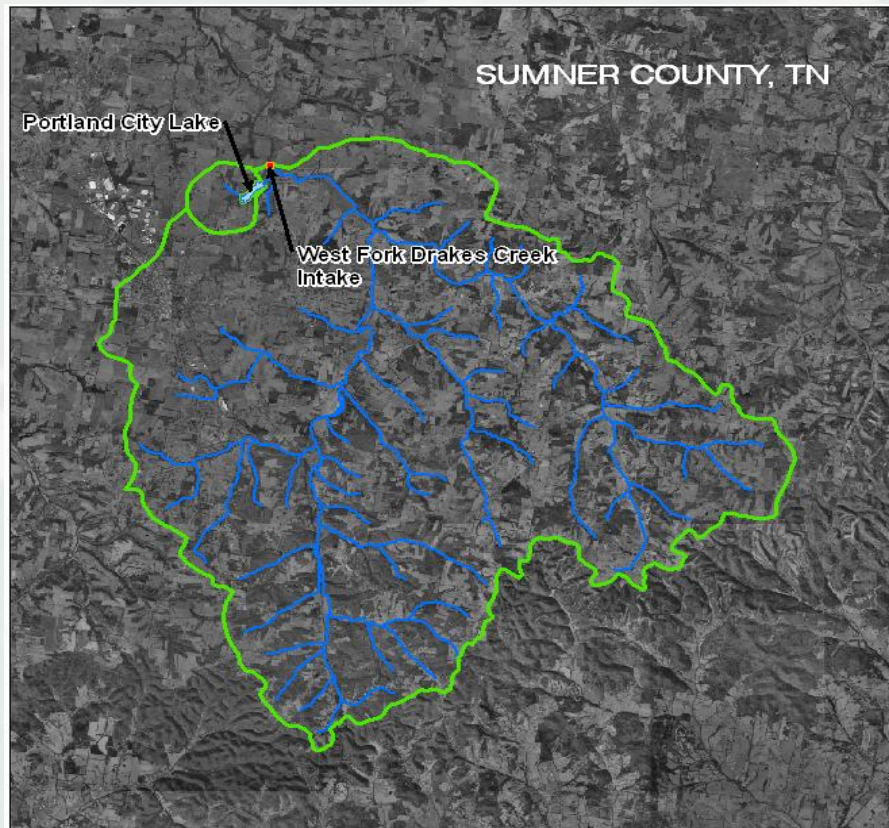
Phase II Progress

- Existing Water Source Yield Analyses
 - ▶ Primary Source of Water for Region is Old Hickory Lake
 - Exception is Portland Which Principally Relies Upon West Fork Drakes Creek and City Lake
 - ▶ Old Hickory Lake is Capable of Meeting Current Demand
 - ▶ Focus on Portland Existing Source Yields



Phase II Progress

- Existing Water Source Yield Analysis



Phase II Progress

- Existing Water Source Yield Analyses
 - ▶ Developed hydrologic models (HEC-HMS) of watersheds with historical precipitation record input
 - ▶ Generated synthetic inflow sequences to reservoir/stream
 - ▶ Utilized sequent peak algorithm to analyze inflow sequence and identify critical drought
 - ▶ Computed firm yield using reservoir storage capacity and sequent peak algorithm



Phase II Progress

- Existing Water Source Yield Analyses
 - ▶ Sequent Peak Algorithm – cumulative tracking of the daily water balance for a reservoir

$$K_t = (D_t - Q_t) + K_{t-1}$$

Where:

K_t = cumulative deficit at time (t)

D_t = demand (yield) at time (t)

Q_t = inflow at time (t)

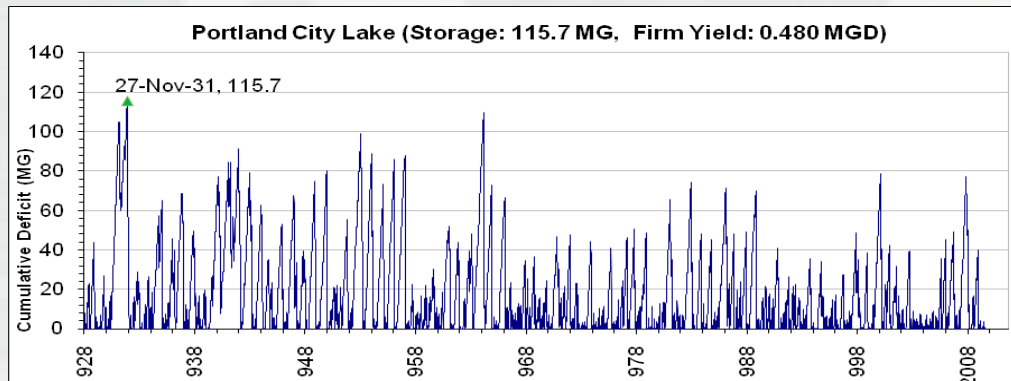
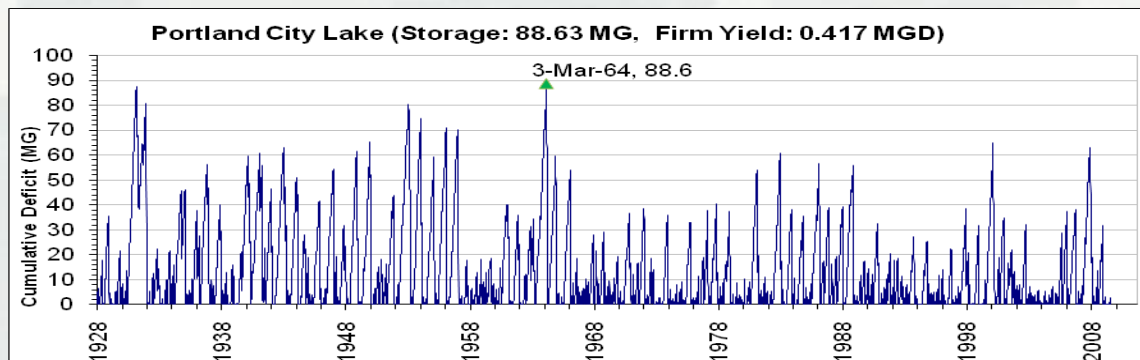
K_{t-1} = cumulative deficit at time (t-1)

- ▶ Firm yield is calculated by solving for the yield at which cumulative deficit is exactly equal to the reservoir's available storage capacity



Phase II Progress

- Existing Water Source Yield Analyses



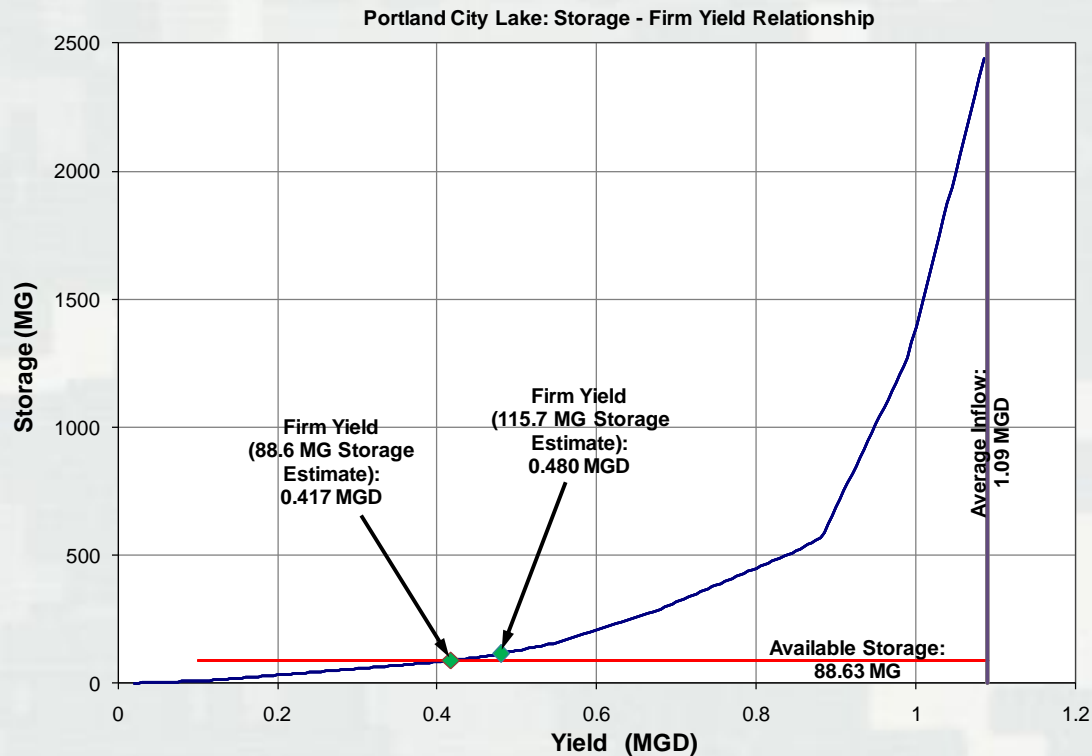
Firm Yield
Computations are
Dependent Upon
Accurate Estimates of
Available Storage in the
Reservoir

Sequent Peak Algorithm (SPA) Plots at a Daily Time-step



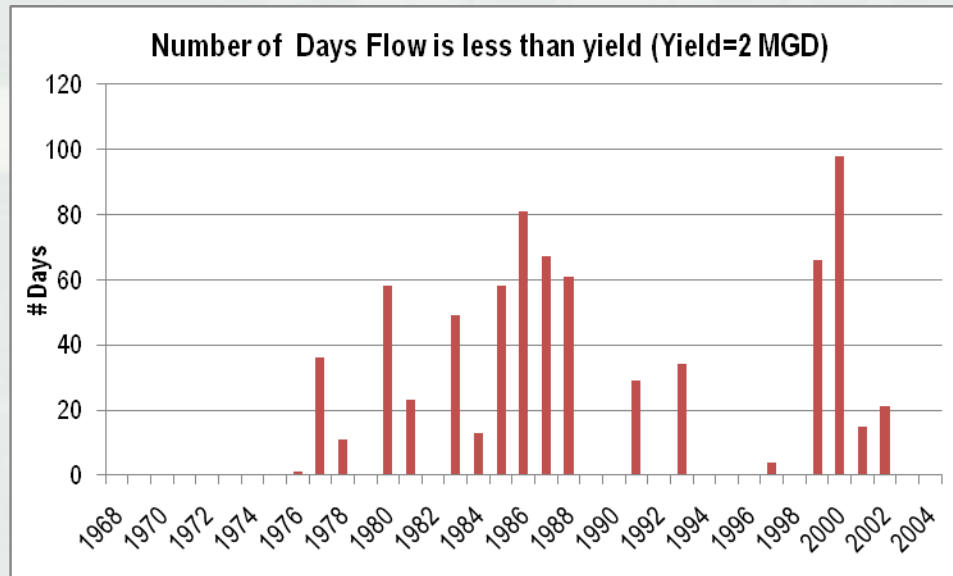
Phase II Progress

- Existing Water Source Yield Analyses



Phase II Progress

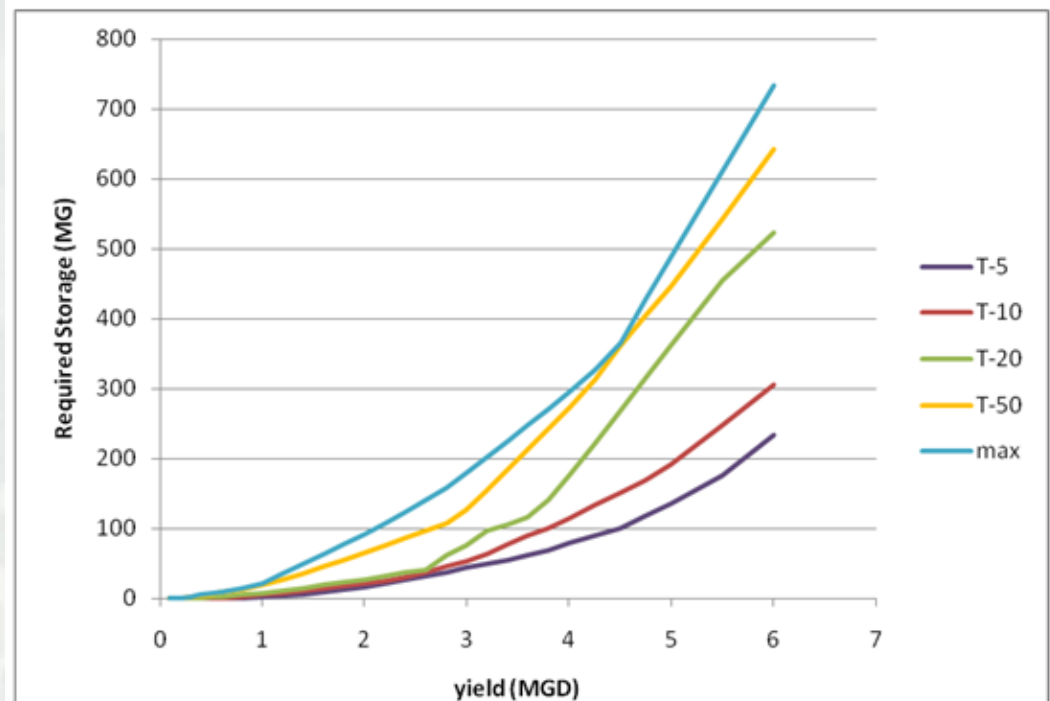
- Existing Water Source Yield Analyses
 - ▶ West Fork Drakes Creek – Examine for a range of withdrawal rates (yield) the ability of the stream to meet demand



Phase II Progress

■ Existing Water Source Yield Analyses

- ▶ Plot represents the amount of storage required to withdraw the yield without fail at a given return period
- ▶ Current Portland average demand is 2 MGD
- ▶ 100 MG storage required in addition to river flows to yield 2 MGD reliably



Phase II Progress

- Additional Data Needs for Firm Yield Analyses:
 - ▶ Portland
 - In-stream storage at West Fork Drakes Creek intake
 - Stage-storage curve for City Lake
 - Lowest intake elevation for City Lake



Phase II Progress

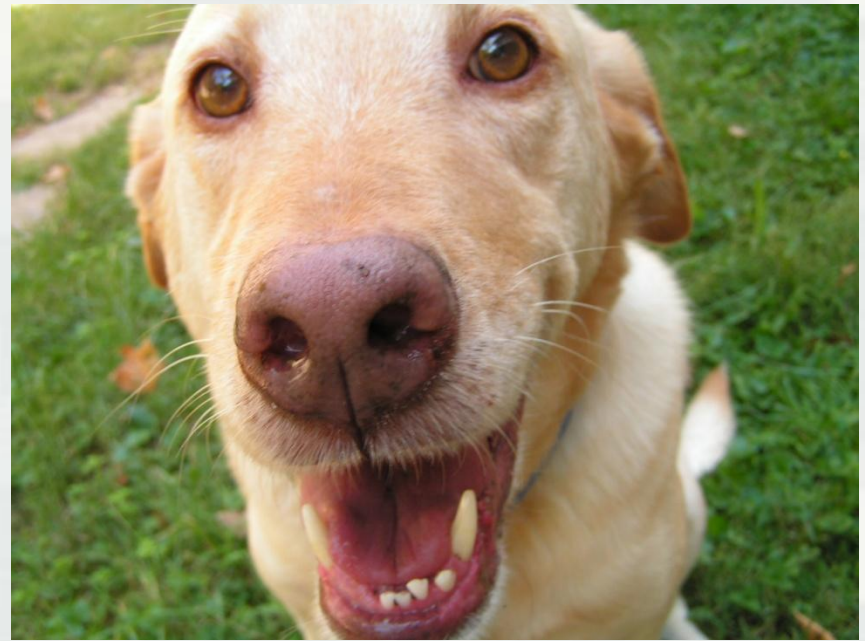
- Water Demand Management Strategies
 - ▶ Existing Practices and Plans Reviewed
 - ▶ Evaluation of Active and Passive Measures Planned
 - Reduce Unaccounted for Water Loss
 - ▷ Metering Improvement, Line Flushing Reduction
 - ▷ Leak Detection and Repair
 - Conservation Pricing
 - New Construction Standards
 - Retrofit, Replacement, Rebate Programs
 - Education



Phase II Progress

- Alternative Water Source Identification
 - ▶ Existing Source Improvement
 - Optimize Water Sharing between Utilities
 - ▶ New Source Development
 - Portland Lake Project
 - Additional Withdrawals from Old Hickory
 - ▶ Yield Analyses not yet Undertaken





Questions/Comments??

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